

WHAT IS CLAIMED IS:

1. An impact absorbing type steering column apparatus provided with collision energy absorbing means for absorbing an energy of a secondary collision of an occupant upon a collision of a vehicle, said apparatus comprising:

energy absorption quantity adjusting means for changing a secondary collision energy absorption quantity of said collision energy absorbing means;

at least one sensor for detecting a condition of the occupant or the vehicle; and

electric control means for controlling a drive of said energy absorption quantity adjusting means on the basis of a result of detection by said sensor.

2. An impact absorbing type steering column apparatus provided with a collision energy absorbing device which absorbs energy of a secondary collision of an occupant upon a collision of a vehicle, said apparatus comprising:

an energy absorption quantity adjusting device which changes a secondary collision energy absorption quantity of said collision energy absorbing device;

at least one sensor which detects a condition of the occupant or the vehicle;

an electric control device which controls a

drive of said energy absorption quantity adjusting device based on a result of detection by said sensor; and

a collapsible column rotatably supporting a steering shaft and which is collapsed with a predetermined collapse load,

wherein said collapsible column includes an outer column, an inner column entering said outer column when said collapsible column is collapsed, and

said collision energy absorbing device has a plurality of metal balls interposed between said outer column and said inner column to plastically form grooves in at least one of said outer column and said inner column when said collapsible column is collapsed.

3. An impact absorbing type steering column apparatus according to claim 2, wherein the plurality of metal balls are constructed of a first group of metal balls retained in a first metal ball retaining structure and a second group of metal balls retained in a second metal ball retaining structure, and

said energy absorption quantity adjusting device is provided with a rotational drive operative to rotate at least one of the first group of metal balls and the second group of metal balls in order to make a part or the whole of angular phases of the metal

balls in the first metal ball group with respect to said collapsible column coincident with or different from the metal balls in the second metal ball group.

4. An impact absorbing type steering column apparatus according to claim 1, further comprising:

a steering column for rotatably supporting said steering shaft; and

a car body sided bracket, fixed to the car body, for supporting said steering column and allowing said steering column to get released therefrom when an impact load equal to or larger than a predetermined value acts,

wherein said collision energy absorbing means is provided between said steering column and said car body sided bracket, and drawing means causes a plastic deformation of an energy absorbing member composed of a metal plate or a metal wire with a shift of said steering column.

5. An impact absorbing type steering column apparatus according to claim 4, wherein said drawing means is a metal rod or a metal ball, and

said energy absorption quantity adjusting means changes at least one of a plastically deformed portion and a plastic deformation quantity of said energy absorbing member by said drawing means.

6. An impact absorbing type steering column apparatus provided with a collision energy absorbing device which absorbs energy of a secondary collision of an occupant upon a collision of a vehicle, said apparatus comprising:

an energy absorption quantity adjusting device which changes a secondary collision energy absorption quantity of said collision energy absorbing device;

at least one sensor which detects a condition of the occupant or the vehicle;

an electric control device which controls a drive of said energy absorption quantity adjusting device based on a result of detection by said sensor;

a steering column rotatably supporting said steering shaft; and

a bracket fixed to a vehicle body, said bracket supporting said steering column and allowing said steering column to be released therefrom in response to an impact load equal to or larger than a predetermined value,

wherein said collision energy absorbing device is provided between said steering column and said bracket, and causes fracture, or bending deformation and fracture, of an energy absorbing member composed of a metal plate with a shift of said steering column.

7. An impact absorbing type steering column apparatus comprising:

a collapsible column rotatably supporting a steering shaft and which is collapsed with a predetermined collapse load,

said collapsible column including:

an outer column;

an inner column entering said outer column when said collapsible column is collapsed; and

a plurality of metal balls interposed between said outer column and said inner column to plastically form grooves in at least one of said outer column and said inner column in order to absorb collision energy when said collapsible column is collapsed,

wherein said steering column apparatus is provided with an energy absorption quantity adjusting device which changes an absorption quantity of the collision energy.

8. An impact absorbing type steering column apparatus according to claim 7, wherein the plurality of metal balls are constructed of a first group of metal balls retained in a first metal ball retaining structure and a second group of metal balls retained

in a second metal ball retaining structure, and

said energy absorption quantity adjusting device is provided with a rotational drive operative to rotate at least one of the first group of metal balls and the second group of metal balls in order to make a part or the whole of angular phases of the metal balls in the first metal ball group with respect to said collapsible column coincident with or different from the metal balls in the second metal ball group.

9. An impact absorbing type steering column apparatus comprising:

a steering column for rotatably supporting said steering shaft;

a car body sided bracket, fixed to the car body, for supporting said steering column and allowing said steering column to get released therefrom when an impact load equal to or larger than a predetermined value acts; and

collision energy absorbing means provided between said steering column and said car body sided bracket, for absorbing an energy of a secondary collision of an occupant by causing a plastic deformation of an energy absorbing member composed of a metal plate or a metal wire by use of drawing means with a shift of said steering column,

wherein said steering column apparatus is

provided with energy absorption quantity adjusting means for changing an absorption quantity of the collision energy.

10. An impact absorbing type steering column apparatus according to claim 9, wherein said drawing means is a metal rod or a metal ball, and

said energy absorption quantity adjusting means changes at least one of a plastically deformed portion and a plastic deformation quantity of said energy absorbing member by said drawing means.

11. An impact absorbing type steering column apparatus comprising:

a steering column rotatably supporting said steering shaft;

a bracket fixed to a vehicle body, said bracket supporting said steering column and allowing said steering column to be released therefrom in response to an impact load equal to or larger than a predetermined value; and

a collision energy absorbing device provided between said steering column and said bracket, said collision energy absorbing device absorbing energy of a secondary collision of an occupant by causing fracture, or bending deformation and fracture, of an energy absorbing member composed of a metal plate

with a shift of said steering column,

wherein said steering column apparatus is provided with an energy absorption quantity adjusting device which changes an absorption quantity of the collision energy.

12. An impact absorbing type steering column apparatus according to any one of claims 1 through 11, wherein an electromagnetic actuator is a driving source of said energy absorption quantity adjusting means.

13. An impact absorbing type steering column apparatus according to any one of claims 2, 3, 6, 7, 8, and 11, wherein an electric motor is a driving source of said energy absorption quantity adjusting device.

14. An impact absorbing type steering column apparatus according to any one of claims 2, 3, 6, 7, 8, and 11, wherein said energy absorption quantity adjusting device changes an absorption quantity of the secondary collision energy by said energy absorbing device in at least three stages.

15. An impact absorbing type steering column apparatus provided with a collision energy absorbing



device which absorbs energy of a secondary collision of an occupant upon a collision of a vehicle, said apparatus comprising:

an energy absorption quantity adjusting device which changes a secondary collision energy absorption quantity of said collision energy absorbing device;

at least one sensor which detects a condition of the occupant or the vehicle; and

an electric control device which controls a drive of said energy absorption quantity adjusting device based on a result of detection by said sensor,

wherein said energy absorption quantity adjusting device changes an absorption quantity of the secondary collision energy by said energy absorbing device in an infinitely variable manner.

16. An impact absorbing type steering column apparatus according to any one of claims 1 through 11, wherein said energy absorption quantity adjusting means changes an absorption quantity of the secondary collision energy by said energy absorbing means in two or more modes, and

energy absorption loads are substantially fixed with respect to a progress of a collapse stroke after points of inflections of energy absorption characteristics in the two or more modes.

17. An impact absorbing type steering column apparatus according to any one of claims 1 through 11, wherein said energy absorption quantity adjusting means changes an absorption quantity of the secondary collision energy by said energy absorbing means in two or more modes, and

energy absorption loads gradually increase with respect to a progress of a collapse stroke after points of inflections of energy absorption characteristics in the two or more modes.

18. An impact absorbing type steering column apparatus according to any one of claims 1 through 11, wherein two types of energy absorption characteristics are exhibited, and

a large load characteristic has a collapse load that is twice or greater as large as that of a small load characteristic after points of deflections of these two types of energy absorption characteristics.

19. An impact absorbing type steering column apparatus according to any one of claims 1 through 11, wherein two or more types of energy absorption characteristics are exhibited, and these two or more types of energy absorption characteristics delay a rise timing of absorbing the energy.

20. An impact absorbing type steering column

apparatus comprising:

a collapsible column rotatably supporting a steering shaft and which is collapsed with a predetermined collapse load,

said collapsible column including:

an outer column;

an inner column entering said outer column when said collapsible column is collapsed; and

a plurality of metal balls interposed between said outer column and said inner column to plastically form grooves in at least one of said outer column and said inner column in order to absorb a collision energy when said collapsible column is collapsed,

wherein said steering column apparatus is provided with a plurality of metal ball retainers for retaining the metal balls in phases different from each other, and a retainer separating device which separates at least one of said metal ball retainers from said member fixed to a vehicle body in order to reduce the number of grooves formed by the metal balls when said collapsible column is collapsed.

21. An impact absorbing type steering column apparatus according to claim 20, wherein said retainer separating device includes an electrically driven actuator.

22. An impact absorbing type steering column apparatus according to claim 21, wherein said electrically driven actuator separates said one metal ball retainer from said member fixed to the vehicle body only when being charged with electricity.

23. An impact absorbing type steering column apparatus comprising:

a collision energy absorbing device which absorbs energy of a secondary collision energy of an occupant upon a collision of a vehicle; and

an energy absorption quantity adjusting device which changes an absorption quantity with which said collision energy absorbing device absorbs the secondary collision energy,

wherein an electromagnetic actuator is a driving source of said energy absorption quantity adjusting device, and

a plunger of said electromagnetic actuator is magnetically held in a predetermined position by a permanent magnet.

24. An impact absorbing type steering column apparatus according to claim 23, wherein said collision energy absorbing device is provided between

said steering column and a bracket fixed to a vehicle body and causes plastic deformation of an energy absorbing member composed of a metal plate or a metal wire by use of a drawing device with a shift of said steering column.

25. An impact absorbing type steering column apparatus according to claim 23, wherein said drawing device includes a metal rod or a metal ball, and said energy absorption quantity adjusting device changes at least one of a plastically deformed portion and a plastic deformation quantity of said energy absorbing member by said drawing device.

26. An impact absorbing steering column apparatus according to claim 2, wherein said sensor is any one of a seat position sensor, a weight sensor, a speed sensor, an occupant position sensor and a seat belt wearing sensor.

27. An electric power steering apparatus adopting the impact absorbing apparatus as set forth in claim 2.

28. An impact absorbing type steering column apparatus according to claim 15, further comprising:

a steering column rotatably supporting said steering shaft; and

a bracket, fixed to a vehicle body, said bracket supporting said steering column and allowing said steering column to be released therefrom when an impact load equal to or larger than a predetermined value acts,

wherein said collision energy absorbing device is provided between said steering column and said bracket, and a drawing device causes a plastic deformation of an energy absorbing member composed of a metal plate or a metal wire with a shift of said steering column.

29. An impact absorbing type steering column apparatus according to claim 28, wherein said drawing device includes a metal rod or a metal ball, and

said energy absorption quantity adjusting device changes at least one of a plastically deformed portion and a plastic deformation quantity of said energy absorbing member by said drawing device.

30. An impact absorbing type steering column apparatus comprising:

a steering column rotatably supporting a steering shaft;

a bracket, fixed to a vehicle body, said bracket

supporting said steering column and allowing said steering column to be released therefrom in response to an impact load equal to or larger than a predetermined value;

a collision energy absorbing device provided between said steering column and said bracket, and which absorbs energy of a secondary collision of an occupant by causing a plastic deformation of an energy absorbing member, composed of a metal plate or a metal wire, by use of a drawing device with a shift of said steering column; and

an energy absorption quantity adjusting device which changes an absorption quantity of the collision energy;

wherein said energy absorption quantity adjusting device changes an absorption quantity of the secondary collision energy by said energy absorbing device in an infinitely variable manner.

31. An impact absorbing type steering column apparatus according to claim 30, wherein said drawing device includes a metal rod or a metal ball, and

said energy absorption quantity adjusting device changes at least one of a plastically deformed portion and a plastic deformation quantity of said energy absorbing member by said drawing device.